

# PATENT SPECIFICATION

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## (54) FRICTION MATERIAL AND METHOD OF MANUFACTURE

(71) We, JOHNS-MANVILLE CORPORATION, a corporation organized under the laws of the State of New York, United States of America, of 22 East 40th Street, New York, State of New York 10016, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to friction facings and a method of manufacturing friction facings.

Applicants have discovered that continuous glass fiber bundles helically wrapped with metallic filaments not only lend strength superior to asbestos fibers when formed into a friction material such as clutch facings, but have desirable frictional and heat-dissipation characteristics as well. This invention is concerned with preparing friction facings using such helically wrapped bundles.

According to the present invention we provide a method of manufacturing friction facings wherein two or more rovings made up of substantially parallel continuous glass filaments and impregnated with a heat curable cement are brought together in substantially parallel relation and continuous metallic filaments are helically wrapped therearound for retaining the rovings in a continuous bundle, the continuous bundle is spirally or randomly wound into a desired shape and size, the uncured spirally or randomly wound continuous bundle is compressed, said cement in the compressed body is cured, and the cured body is then ground to a proper thickness to form a friction facing.

The invention will now be described with reference to the accompanying drawings in which:—

Figure 1 represents the process by which two or more glass rovings of continuous glass

filaments are processed into a continuous bundle according to this invention;

Figure 2 is a cross-sectional view taken along line 2—2 of Figure 1;

Figure 3 is a cross-sectional view taken along line 3—3 of Figure 1;

Figure 4 is a slightly enlarged plan view of a spin table mechanism for helically applying a wire filament around the rovings to define a bundle;

Figure 5 is a cross-sectional view taken across the bundle along lines 5—5 of Figure 1;

Figure 6 is a substantially full size representation of a section of continuous bundle;

Figure 7 represents a continuous bundle being drawn from a spool and spirally wound upon itself into disc form;

Figure 8 is an elevation or face view of a friction member, such as a clutch facing in accordance with the invention;

Figure 9 is a side or edge view of the disc shown in Figure 8; and

Figure 10 is a fragmentary enlarged sectional view taken generally along line 10—10 of Figure 8.

Referring to the drawings, and in particular to Figure 1, there is illustrated a process by which continuous rovings from packages of fiber glass are processed into a continuous bundle for use in clutch facings.

The process of drawing heat softened glass into continuous filaments is well known in the art. Only brief description is made herein, primarily to define terminology. Individual glass filaments in groups of from 200—800 are drawn from the bottom of heated bushings or pots into which is fed molten glass. The filaments for the requirements of the present invention range in diameter from 12—14 microns. The 200—800 filaments are collected together to define a strand. In subsequent

operation from 10—120 strands are collected to define a roving. The roving is collected in a hollow cylindrical package to a size of 8—10 inches in diameter by about 10 inches long and weighing some 15—30 pounds. The roving, which forms the package, is of continuous length and is adapted to be drawn from the package for processing according to this invention. To summarize, the following definitions are established:

- One Strand = 200—800 individual continuous ECK (electrical-continuous glass filaments each having a diameter in the range of about 12—14 microns). (1 micron = .00003937")
- One Roving = 10—120 strands.
- One Bundle = 6—8 rovings held together in continuous form, e.g., by helically applied brass wires.
- Package = Continuous roving wound into a cylindrically shaped package and adapted for subsequent removal therefrom.
- Continuous = Generally uninterrupted for a considerable length (e.g., several thousand feet)

In Figure 1, packages of roving, generally identified by the numerals 10, are maintained in a position so that rovings generally identified by the reference numeral 12 are adapted to be pulled or unwound therefrom. These rovings pass through a combing device 14 where they are maintained slightly spaced apart as they pass around a roller 16 in a cement bath 18. This spacing provides an opportunity for the cement to penetrate more easily to all fibers of each roving. A cement 18 is maintained in quantity and depth in a tank 20 to insure thorough impregnation of each roving by the time it passes upwardly therefrom toward an eyelet 22. The opening of the eyelet 22 is somewhat larger than the combined bulk of the rovings 12 passing therethrough and acts to wipe off excess cement which falls back into the tank 20. The composition of the cement 18 will be disclosed later in this specification. The rovings 12, which were brought together at the eyelet 22, are again separated as they pass through respective individual openings in a rosette disc 24. Any remaining excess cement is wiped from the strands individually as they pass therethrough.

The rovings (now separated) pass upwardly through an upstanding drying tower 26 having a chamber where steam is admitted for driving off volatile hydrocarbon parts of the cement 18. Steam at about 335°F is admitted through a port 28 to the tower chamber and exhausted through a port 30 at about 275°F. Steam is preferred in the tower 26 for mixing with the most volatile parts of the cement so as to reduce danger of

fire or explosion. These fumes are discharged along with the steam.

The partially dried rovings pass from the top of tower 26, over a pulley arrangement 32, 34 into the top of a second tower 36. As the rovings pass downwardly therethrough, the cement is further exposed to hot air at 350—400°F which is admitted at a middle port 38 and exhausted through an upper port 40 and a lower port 42. The rovings pass through both the towers 26 and 36 as individual rovings and do not normally become attached together by the cement. At the entrance to the tower 26 they are maintained separately by the rosette and the cement becomes progressively drier as the rovings progress through the towers. The rovings do not normally adhere together, but no substantial disadvantage results if they do.

The cement 18 may be comprised of many formulations common in friction clutch manufacture. Applicants identify the following as one cement found successful for use to impregnate the glass rovings: Rubber 30—40 percent; accelerator and curing agent, such as DOTG (di-orthotolylguanidine), 20—30 percent; resin 15—30 percent; and, filler 20—30 percent.

The rovings 12 pass downwardly from the bottom of the tower 36 through winding apparatus, identified generally by the numeral 60, where filaments, such as brass wire, are helically wound around the rovings to retain them into a bundle, generally identified by reference numeral 49. The helically wound bundle 49 is thereafter wound onto a spool 50 which is rotated slowly by a motor 52 driving through a gear reduction (not shown) and a pair of friction rolls 54 and 56. The roll 56 bears against the surface of the bundle 49 being wound onto the drum so as to drive the periphery thereof at a constant linear speed of about 10—20 feet per minute. By the winding action of spool 50, the entire continuous rovings are drawn through the process just described.

The winding apparatus 60 (also see Figure 4) comprises essentially a revolving platform 62 carrying a number of spools 66 of filament, such as brass wire, in orbit about the plural roving 12 for helically wrapping them around the continuous bundle 49. As shown in Figure 4, a platform 62 has an axial opening 63 which permits the rovings 12 to pass vertically therethrough. A motor 64, driving through a worm gear arrangement or like gear reduction box (not shown), revolves the platform 62 at a rate to helically lay brass wire or other filaments around the several rovings at the desired advance or pitch. This holds the rovings in a substantially continuous bundle, a portion of which is illustrated at approximately full scale in Figure 6. Spools 66 each carry a brass wire 68 having a diameter of around .007 inch. The spools are preferably

located at different heights, respectively, from the upper face of the platform 62. This permits the wires therefrom to be wound onto the bundle at spaced helices as illustrated in Figure 6. The wire will comprise about 2—4 percent of the weight of the bundle. The helical wrapping may be made with materials other than brass, for example, zinc, other metals and alloys. filaments may be used. One purpose of the helical wrapping is to retain the continuous bundle. Metallic filaments, of course, have an advantage of rapid heat transfer within a friction material.

The platform 62 is rotatably mounted in a housing 70 as shown in Figures 1 and 4. The housing protects the revolving parts from outside interference and also defines a guard for protecting workmen.

When the spool 50 has collected the desired amount of the continuous bundle 49, the bundle is severed and the full spool removed. The continuous bundle is then started on an empty spool and wound thereon as before.

The application of a number of wires 68 to the roving 12 hold the rovings in a bundle for ease in subsequent handling and forming onto the spool 88. The wires also provide from about 2—4 percent by weight the friction material in the facing. This renders the desired frictional surface and defines means for heat transfer from the actual surface which comes into contact with a frictional driving member to the interior of the material.

The continuous bundle 49, after being helically wrapped, is stored on spools or drums in lengths of several hundred to over a thousand feet for subsequent use. Figure 7 illustrates schematically the process by which the continuous bundle 49 is supplied from a spool 88 and spirally wound onto a revolving mandrel mold 90. This preform comprises a pair of plates 92 mounted on a rotatable shaft 94. The plates are axially spaced apart a selective distance equal to the desired thickness of the disc preform. The continuous bundle 49 is started around the shaft 94 and slowly wound in spiral configuration so that the length keeps building up on itself in ever increasing radii. Alternatively, the bundles may be applied by random winding wherein the bundles are constantly varying in the instantaneous radius at which they are being wound.

The uncured spirally wound disc preform material is removed from the mandrel 90. It maintains itself in a disc form by the friction between adjacent and overlapping bundle portions resulting from the winding operation. The inherent tackiness of the uncured cement composition also helps to hold the bundle in position. The uncured preform is then placed between flat platens under pressure in the range of 2000 to 2500 psi and cured at a temperature of from 320 to 340°F for 4 minutes. This initial cure hardens the cement

to a nonflow condition. Thereafter, the partially cured and densified preform 15 removed and subjected to a post bake for completing the polymerization of the resins. The post bake comprising further curing under reduced pressure for about 6 hours at 350°F and 2 hours at 400°F. Upon completion of this post cure, the resultant disc is ready to have the flashing removed and be ground to the proper thickness. The finished facing 96 is provided with rivet holes 95 having counterbores for reception of attaching rivets for securing the facings to a clutch plate or brake mounting, not shown.

The bundle 49 in the state shown in Figures 1 and 2, impregnated with cement and wrapped with brass wires, comprises fly weight ECK glass filaments in the range of 45 to 50%; cement in the range of 47—51%; and brass wire from 3—4%. As indicated, volatile hydrocarbons have been expelled from the cement prior to having helical wrappings of brass wire applied therearound. In such a state the continuous bundle is bendable and pliable so that it can be easily wound upon mandrel 90. The parallel glass filaments in the bundle are adapted to follow the desired contour and be wound over each other to generally fill all the spaces in the preform 90. The brass filament windings, since they extend around the outer periphery of the glass filament in bundle 49, are exposed to either face of the friction material. Each filament that is exposed to the surface also extends deep within the facing material since it encircles the bundle. They serve to hold the bundle and transmit heat. Figure 10, which is an enlarged sectional view taken generally along line 10—10 of Figure 8, shows the bundles made up of 6 to 8 rovings which have been built up spirally one on another. The individual filaments continue to lie generally parallel to each other as they did in the roving or strand stage. As the bundle is spirally wound to define the body of the preform, the fibers are oriented to lie generally arcuately at a general radius from the center. The wear or friction surface of the clutch facing includes glass filaments with their sides generally present for frictional contact with a flywheel.

Continuous glass fibers, with sides exposed to friction contact, provide a clutch facing having equal to superior performance when compared to asbestos fibers, and a marked superiority in spin strength. A number of tests have been run on clutch facings of identical size and the results of these tests are tabulated as follows:

Hot Spin Strength (RPM) (1)		
Asbestos (2)	Glass (3)	
8,558 <sup>(4)</sup>	12,450 <sup>(4)</sup>	
8,442	13,288	
7,500	12,667	

	1. 500°F; size—10.4 inches×6.5 inches×.135 inches thick.	
	2. Short length asbestos fibers intertwisted with brass wire.	
5	3. Glass fibers in continuous bundles helically wrapped with brass wire.	
	4. Each figure represents average of six specimens.	
	8,550	11,817
10	7,567	12,867
	9,350	12,100
	8,417	11,933
	9,003	11,567
	8,717	12,267
15	9,617	12,033
	8,283	11,550
	9,717	12,500
	9,183	12,967
	10,333	12,750
20	9,783	13,366
	10,167	13,000
	9,950	13,275
	9,066	13,300
	8,933	13,033
25	8,650	13,250
	9,258	
	8,280	12,614 Average
	9,750	
	10,383	
30	10,234	
	9,069 Average	

It will be seen that substantial burst strength is provided by clutch facings formed by spirally wrapping continuous glass filaments upon themselves in the manner disclosed and claimed herein. Clutch facings using glass fibers have equal or better wear, face and torque transmittal characteristics to define a commercially superior friction material.

#### 40 WHAT WE CLAIM IS:—

1. A method of manufacturing friction fac-

ings wherein two or more rovings made up of substantially parallel continuous glass filaments and impregnated with a heat-curable cement are brought together in substantially parallel relation and continuous metallic filaments are helically wrapped therearound for retaining the rovings in a continuous bundle. the continuous bundle is spirally or randomly wound into a desired shape and size, the uncured spirally or randomly wound continuous bundle is compressed, said cement in the compressed body is cured, and the cured body is then ground to a proper thickness to form a friction facing.

2. The method defined by Claim 1 wherein the metallic filaments are a non-ferrous wire.

3. The method defined in either one of Claims 1 or 2 wherein the metallic filaments are of brass.

4. A method as defined in either one of Claims 1 or 2 wherein the metallic filaments are of zinc.

5. The method as defined in any one of Claims 1—4 wherein the cement is at least partially dried to remove some volatiles contained therein prior to the rovings being helically wrapped.

6. A method as defined in any one of Claims 1—5 wherein the ground disc is then provided with rivet holes for securing the disc to a clutch plate or brake mounting.

7. A friction facing manufactured in accordance with any one of Claims 1—6.

8. A method of manufacturing friction facings as claimed in Claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

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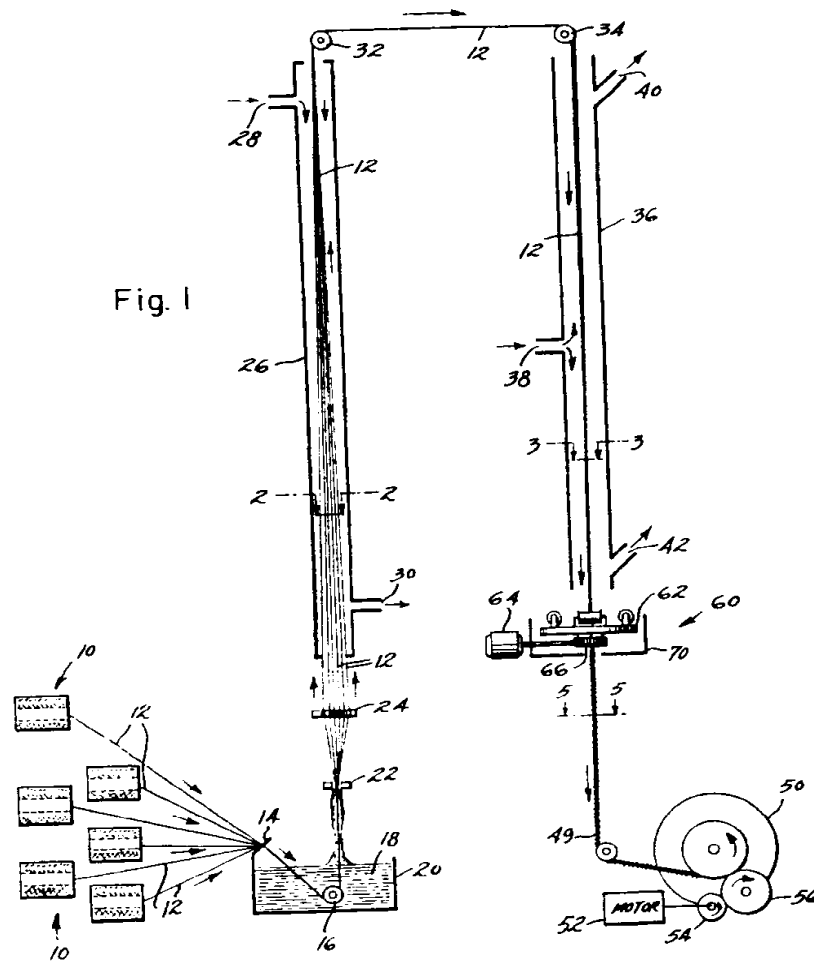
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COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of  
the Original on a reduced scale

Sheet 1



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COMPLETE SPECIFICATION

3 SHEETS

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Sheet 2

Fig. 2

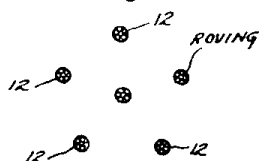


Fig. 3



Fig. 4

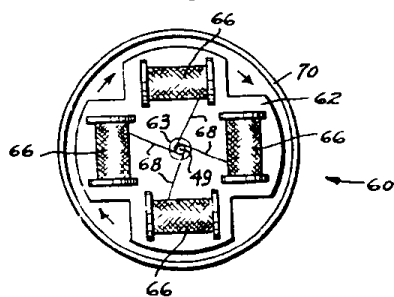


Fig. 5

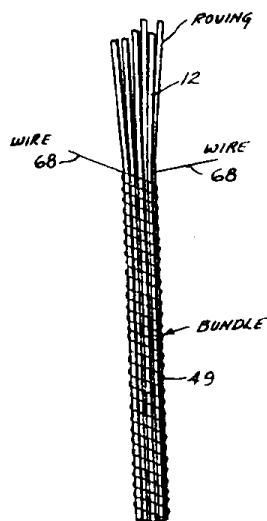


Fig. 6

